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G06K 19/077

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None

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UK CL (Edition K) B6A AK
INT CL[5] G06K

(54) Integrated circuit card or token

(57) An integrated circuit card or token having an insert with an IC element 12 encapsulated in a glob top resin 18 includes a region 20 of progressively increasing compliance peripherally outwardly from the encapsulated IC element so that the card, upon flexing, has bending stresses distributed over a greater area than heretofore. The region 20 forms a ring having a thickness that tapers outwardly from the resin 18. The material of the ring may be an epoxy adhesive. A cap 24 may overlie the resin 18. The substrate 10 of the insert and the overlying film 22 are flexible and are deformed about the ring 20. The layers 56, 58 of core material are moulded thereon.

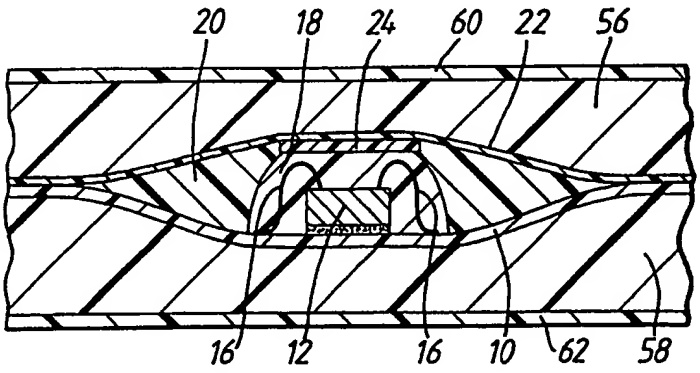

Fig.11

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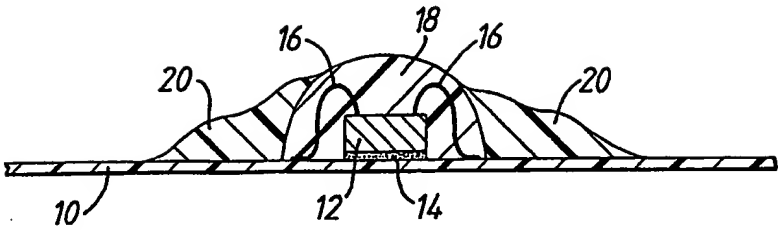

Fig.1

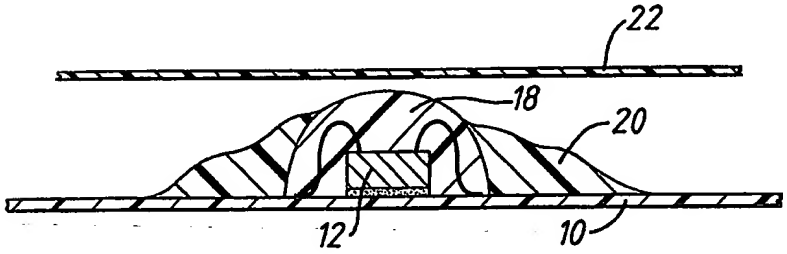

Fig.2

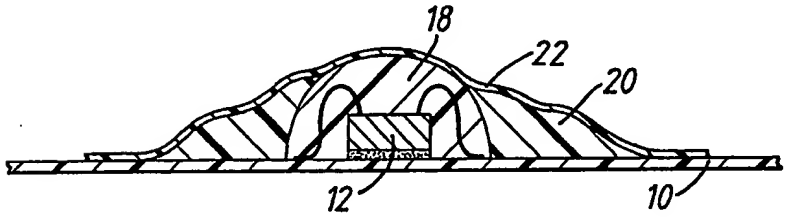

Fig.3

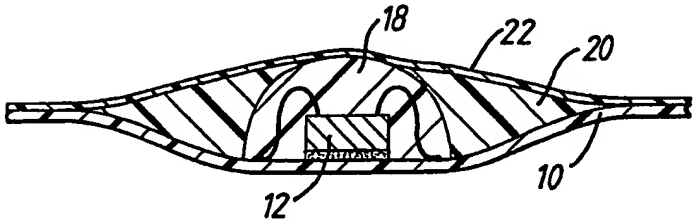

Fig.4

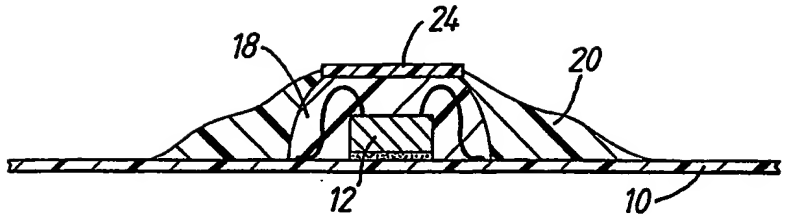

Fig.5

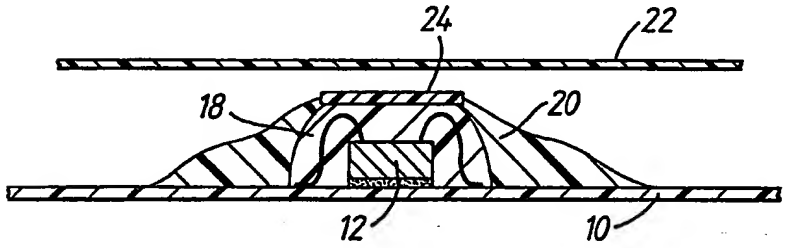

Fig.6

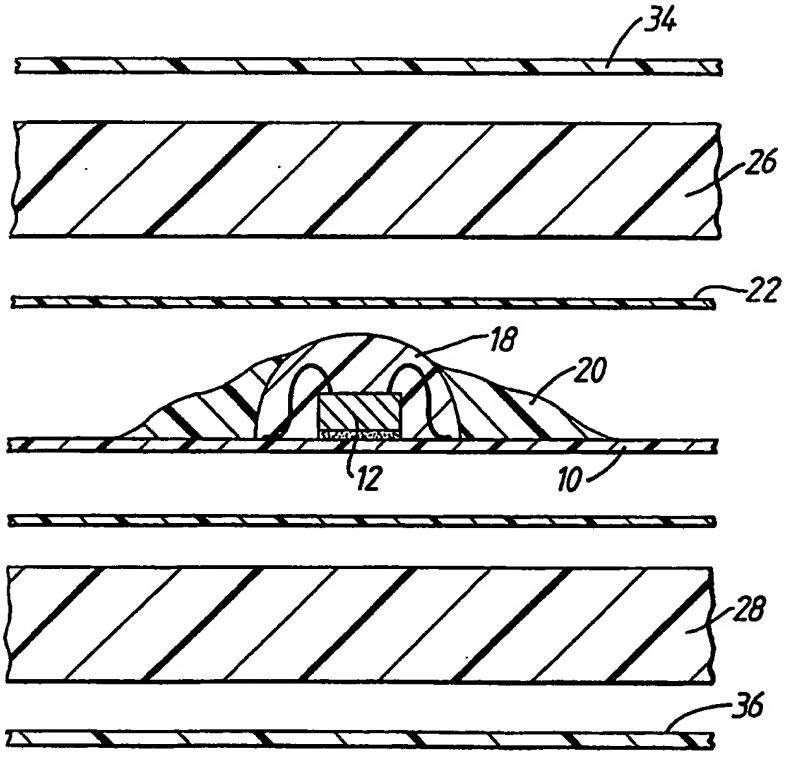

Fig.7

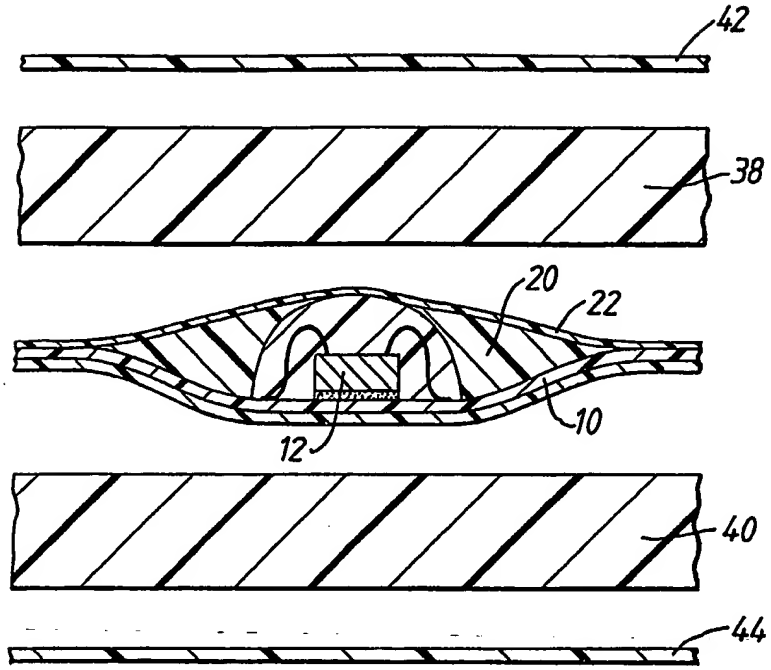

Fig.8

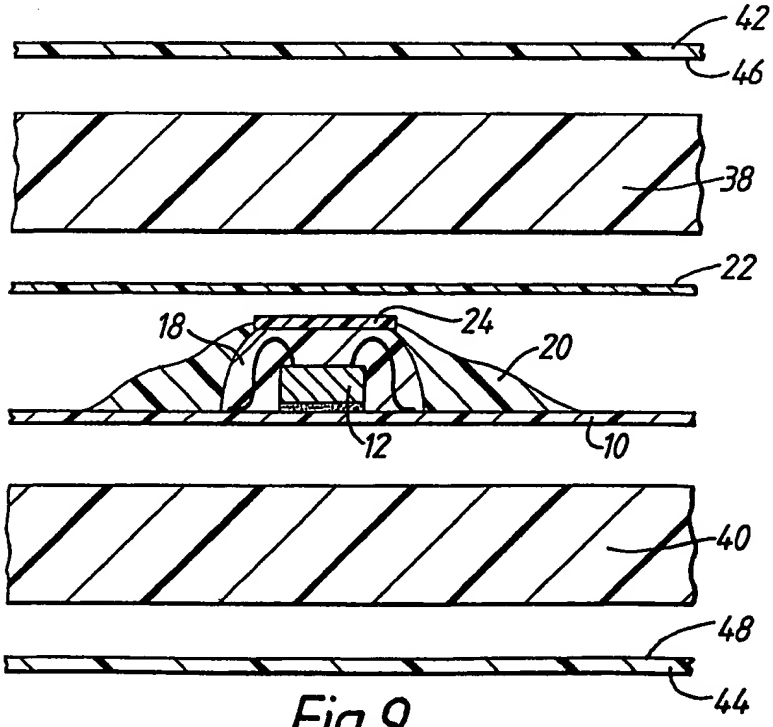

Fig.9

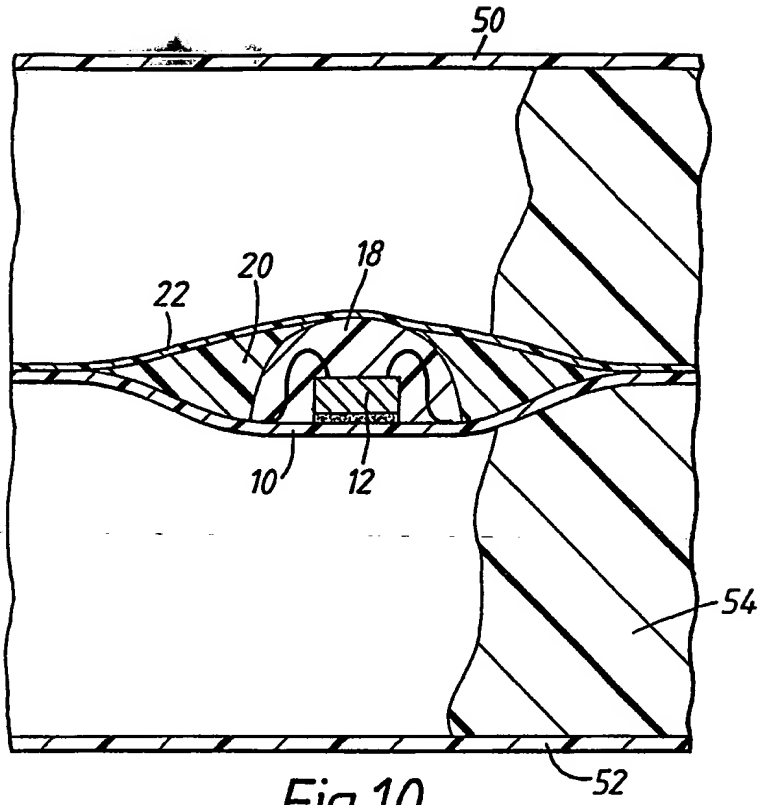

Fig.10

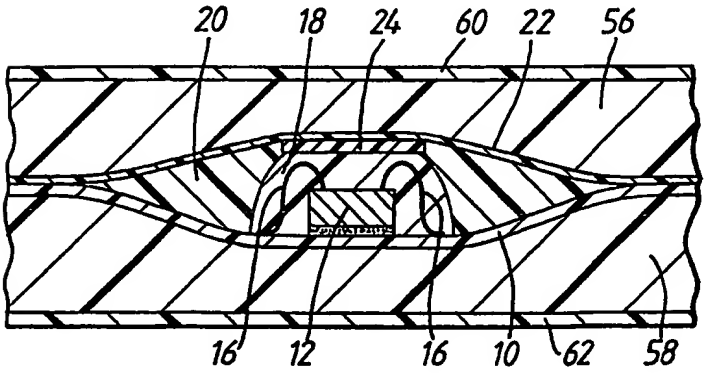

Fig.11

INTEGRATED CIRCUIT CARDS

This invention concerns integrated circuit cards. Although described herein as cards, it will be appreciated that the invention is also directed to tokens. A characteristic of such cards is that they comprise one or more electronic components encapsulated therein. The component may be in the form of an integrated circuit and, as such, is inherently fragile. As the card (or token) must possess a degree of flexibility, it has proved necessary to protect the component against such flexing.

First attempts to so protect the component or components were to encapsulate the same in a hard glob top resin substantially incapable of flexing. The glob top materials are generally adhesive types of material whose chemistry is modified to provide an ionically clean environment to protect the integrated circuit. This modification, additionally, reduces the materials ability to adhere to the substrate forming a weak interface. The component is thus protected but the flexible card/periphery of the encapsulated component interface is weak and bending stresses over the area of the encapsulated component are transferred to this interface. If the encapsulated

component is present at the surface of the card, there is a tendency for the component to break out of the card. If the component is buried in the thickness of the card, then the card (or token) may break at this interface.

Other or additional forms of reinforcement are known, for example as described in our UK Patent Application Publication No. 2227209 filed 18th January 1990. The arrangement there shown restrains the card from flexing over a greater area though with a lesser modulus of rigidity than that of the encapsulated component per se. The tendency of the component to break out or of the card (or token) to break is much reduced. However, greater stress is still applied at the interface between the reinforced area and the substrate or interconnecting medium or the card in general.

It is an object of the present invention to provide an insert for an integrated circuit card or token and such a card or token wherein the aforesaid disadvantage is further minimised. The invention also provides a method of manufacturing the insert and the improved card.

According to the present invention, there is provided an insert, for a card or token formed of a pliable deformable material, comprising a substrate which can carry

electrical interconnections, an element to be protected mounted on the substrate which can carry electrical interconnections, a rigid material encapsulating the element and, contiguously and peripherally of the rigid material, a ring of material of compliance less than that of the pliable material and of adhesive ability greater than that of the rigid material, the ring having a thickness tapering outwardly from the rigid material.

The invention also provides a card or token having an insert as aforesaid and formed of a pliant material.

Further within the scope of the present invention is a method of manufacturing an insert, for a pliant card or token, comprising the steps of mounting an element to be protected upon a substrate, encapsulating the element in a rigid material, surrounding the encapsulated element with a contiguous ring of material of compliance less than that of the pliant card or token and of adhesive ability higher than that of the rigid material, and deforming the ring of material to taper outwardly from the encapsulated element.

Specifically, the invention provides a method of manufacturing a card or token comprising the steps of interposing between first and second layers of a pliant

material 11(1), a substrate having an element to be protected mounted thereon with a glob top resin settable to a rigid state applied to and encapsulating the element 11(2) a ring of a material of compliance less than that of the pliant material but of adhesive ability higher than that of the set glob top resin surrounding and contiguous with the glob top resin 11, deforming the ring so that it tapers outwardly of the encapsulated element and deforming the inner surfaces of the first and second layers so that they conform to the encapsulated element and its ring.

The inner surfaces of the first and second layers are preferably deformed to an extent such that the encapsulated element and its ring be on the neutral axis of the card or token.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic cross-section of a basic form of insert for a card or token, in accordance with the present invention;

Figures 2 and 3 are views, similar to Figure 1, of a

second embodiment of an insert according to the present invention;

Figure 4 is a view, similar to Figures 1 to 3, of a modified form of the insert shown in Figure 3;

Figure 5 is a view, similar to Figure 1 of an insert in which encapsulation of an element is of predetermined thickness;

Figure 6 is a view, similar to Figure 2, but using the predetermined thickness encapsulation of Figure 5;

Figure 7 is an exploded view of the components of a card or token and insert, in accordance with the present invention;

Figure 8 is a view, similar to Figure 7 but illustrating the insert of Figure 4.

Figure 9 is a view, similar to Figures 7 and 8, but illustrating the preferred components of a card or token, and its insert, in accordance with the present invention;

Figure 10 is a diagrammatic cross-section of the

components of a card or token, and its insert in accordance with the present invention, illustrating a method of manufacturing different from that of Figures 7, 8 and 9; and

Figure 11 is a diagrammatic cross-section of a card or token, in accordance with the present invention.

Referring firstly to Figure 1, there is shown an insert, for a card or token, in accordance with the present invention. The insert comprises a substrate 10 of for example, a polyimide. The substrate 10 is thin and flexible and bears, on one surface, an electrical circuit (not visible). An element 12 to be protected is an electronic component, for example, an IC. The element 12 is mounted to the substrate 10 by means of an adhesive 14 and connectors or fine wire bands 16 connect the element 12 with the electrical circuit on the substrate 10. An IC, for example, is physically and environmentally fragile and, to protect the element 12, it is encapsulated by a blob 18 of typically an epoxy resin commonly known as a glob top resin. The blob 18, when set, is hard and has a high modulus of rigidity (compared to that of the other components of the card or token described herein). The modified chemistry of the epoxy resin (providing an ionically clean environment) unfortunately lowers their adhesive ability relative to

other parts of the card. This increases the weakness of the interface between the glob top resin and the remainder of the card with possibly deleterious effects on the integrity of the card. A card or token incorporating such an encapsulated element, when flexed, produces maximum stress at the periphery of the inflexible encapsulated element 12. The invention seeks to minimise this problem.

In accordance with the present invention, the encapsulated element 12 is provided with a ring 20 of a material, the compliance of which is preferably greater than that of the encapsulating blob 18 but which material is highly adhesive. Moreover, the ring 20 has a thickness which reduces from its contiguity with the blob 18 outwardly, that is, the thickness tapers outwardly from the encapsulated element 12. As shown, the thickness of the ring 20 tapers to nothing so that the compliance of the structure shown in Figure 1 varies from a minimum in the region of the encapsulated element 12 and blob 18 up to a maximum, at zero thickness, which maximum is equal to the compliance of the flexible substrate 10.

As shown in Figures 2 and 3, the ring 20 is defined by a superimposed flexible film 22 of, for example, a polyester which may be only 50 microns thick, which is pressed onto

the blob 18 and the ring 20 to contain the ring 20 between itself and the substrate 10. The material for ring 20 would typically consist of a very adhesive trayhered epoxy, applied as a liquid by means of a dispenser, and cured in position.

As shown in Figure 4, pressure is applied to the structure so as to deform both the film 22 and the substrate 10 substantially symmetrically about the ring 20 so that the latter tapers from the thickness of the blob 18 to a feather-edge where the substrate 10 and film 22 meet.

The film 22 when deformed and bonded to substrate 10 further reduces the tendency of the substrate 10 to peel away from the glob top 18.

It will be appreciated that the structures shown in Figures 1 to 4 may each a represent a single insert of a plurality of inserts at predetermined locations on a continuous web forming the substrate 10 and, in the arrangement shown in Figures 2, 3 and 4, a continuous film 22. Such a plurality of inserts may be used to form cards or tokens in batches or in a continuous manner.

An improved insert is shown in Figure 5. In this

embodiment, a cap 24 may be superimposed on the blob 18 before the latter has set or cured. The cap 24 enables the blob 18 to be pressed to a predetermined thickness before it hardens and cures. The provision of the cap 24 and the pressing is preferably effected before the application of the material of the ring 20.

Figure 6, similar to Figure 2, shows that the ring 20 may be contained by a deformable film 22 in the manner shown in Figure 3 or Figure 4.

Figure 7 shows the components of a card or token. The insert, as described in relation to Figures 1 to 4 (or Figure 5 or Figure 6) is positioned between first and second core layers 26, 28 of a mouldable material or mouldable materials. In one embodiment, the layers 26 and 28 are thermoplastic, for example PVC.

At least one of each confronting pair of surfaces, that is, the lower surface of the film 22 and the upper surface of the substrate 10; the upper surface of the film 22 and the lower surface of the core layer 26; the lower surface of the substrate 10 and the upper surface of the core layer 28, is coated with an adhesive so that, on bringing the layers together, the layers cohere to form an

integral structure.

Skins 34, 36 are provided for the outer surfaces of the core layers 26, 28. The skins are preferably of clear PVC and may be pre-printed with graphics on that surface 46, 48 of each skin confronting its adjacent core layer.

As stated above, the layers 26 and 28 are of a mouldable material. In the case of thermoplastic core layers, the individual layers are superimposed in register, for example, in a heated mould (not shown). The mould is heated to a temperature above the glass transition temperature of the core layers 26, 28 and is closed to bring the layers together and to cause the film 22 (and preferably the substrate 10) to deform symmetrically as shown in Figure 4, and the inner surfaces of the core layers 26, 28 to mould to the contours of the insert so formed. The resultant card or token (see Figure 11) is of constant thickness with planar outer surfaces and with the insert disposed on the neutral axis of the card to minimise tensile and compress stresses.

If required, the superimposed layers shown in Figure 7 may be brought together under vacuum conditions so that minimum occlusion of air take place.

The adhesive on the confronting surfaces, as described above, may be heat-activated so that the temperature at which the layers are brought together in a mould serves also to activate the adhesive (or adhesives) and causes the layers to bond together to form an integral structure of card or token.

Figures 8 and 9 show exploded card structures similar to that shown in Figure 7 except that, in Figure 8, the inset is preformed and is of the kind shown in Figure 4. Figure 9 shows a structure in which the insert is not preformed and in which the blob 18 is capped by a cap 24 (as shown in Figure 6) to ensure the thickness of the encapsulated element 12 in its blob 18 is of predetermined thickness.

In the embodiments shown in Figures 8 and 9, the core layers 38 and 40 may be formed of cohesive layers of a mouldable dough. The dough comprises blocked catalyst thermosetting liquid polyester mixed with sufficient filler to give the mixture a dough-like consistency. The mixture is rolled to form thin cohesive mouldable layers.

Skins 42 and 44 which may be of a polyester or a

polycarbonate are positioned respectively above and below the core layers 38 and 40. For example, the skin 44 may be positioned in a mould, the layer 40, the insert, the layer 38 and the skin 42 superimposed thereon and the mould closed to bring the layers together. The layers 38 and 40 conform at their inner surfaces to the insert therebetween, and the dough mixture is allowed to cure to provide the card or token.

The superimposed layers may be rolled to express air or the layers may be brought together in a vacuum.

As with most curable polyesters, the mould may be heated to expedite curing of the layers 38 and 40.

Adhesives, heat activated or otherwise, may be provided, as necessary, on the confronting surfaces of the various layers to bond the same and create an integral structure.

Referring to Figure 9, the exploded structure there shown does not use preformed inserts. Further, skins 42 and 44 bear printing or other graphical representations on their inner surfaces 46, 48. The core layers 38 and 40 may be of a dough-like mouldable material as described in relation to

Figure 8. The several layers are superimposed in a mould and the mould closed to effect curing of the curable polyester mix. Alternatively, the layers 38 and 40 may be of thermoplastic (PVC) sheet as described in relation to Figure 7. The stack of materials would be heated between plates in a laminating press until the sheets 38 and 40 had softened and the adhesive layers activated. Then the stack would be squeezed to deform the layers and bond them together.

As described above, the layers may be brought together in a vacuum to avoid the inclusion of air in the structure. Again, the mould is preferably heated to expedite curing of the mouldable layers 38 and 40.

Yet another method of manufacturing a card or token, having a preformed insert, according to the invention, is shown in Figure 10. As shown in this figure, a pair of skins 50, 52 (or a single folded skin) are clamped or sealed at the edges to form a tube whereinto a liquid mouldable plastics material 54 is injected for example on each side of the substrate 10. The tube is rolled (from right to left as shown) to expel air and clamped in a mould to permit the liquid plastics material to set and to form the card or token.

The inserts described above in relation to Figures 1 to 6 and the methods described in relation to Figures 7 to 10 all serve to produce a card or token as shown in Figure 11. The element 12 to be protected is encapsulated in a rigid material 18 (which may be pressed using a cap 24 to a predetermined thickness). The encapsulated element is surrounded by a ring 20 of a material, the compliance of which may be greater than that of the rigid material 18 but less than that of the core materials 56 and 58 of the card or token and adheves strongly to substrate 10. The ring 20 tapers outwardly of the encapsulated element 12, preferably symmetrically, and the layers 56 and 58 of the core material conform at their inner surfaces to the shape of the insert so formed. Skins 60 and 62 provide glossy scratch resistance external surfaces and may themselves be printed upon their inner surfaces or may serve to protect printing upon the external surfaces of the layers 56 and 58.

A card or token so formed provides a greater area over which stress is applied, on flexing of the card or token, and thus avoids the heretofore deleterious high concentration of stress at the interface peripheral to an encapsulated element within a card which inter alia, would tend to break the connections of wire bonds 16 to substrate

10.

The card or token as described is a contactless card or token and the substrate 10 provides electrical interconnection, and means for inductive coupling of the electronic component or components to an external terminal. It will be appreciated that contacts could be brought out to apertures in the external skins to permit a contact type card or token to be formed.

The cards or tokens above described, their inserts, and their methods of manufacturing are applicable to single, batch or continuous manufacture.

CLAIMS

1. An insert, for a card or token formed of a pliable material, comprising a substrate, an element to be protected mounted on the substrate, a rigid material encapsulating the element and, contiguously and peripherally of the rigid material, a ring of highly adhesive material of compliance less than that of the pliable material, the ring having a thickness tapering outwardly from the rigid material.

2. An insert as claimed in claim 1 wherein the rigid material encapsulating the element to be protected is a rigid plastics material.

3. An insert as claimed in claim 1 or 2 further including a flexible membrane over the insert and conforming to the rigid material and the ring.

4. An insert as claimed in claim 3 wherein the membrane and the substrate are both flexible and conform substantially symmetrically to the rigid material and the ring.

5. An insert as claimed in any one of claims 1 to 4 wherein the ring is of equal thickness to that of the rigid

material at its contiguity therewith.

6. An insert as claimed in any preceding claim wherein the thickness of the ring tapers outwardly to zero.

7. An insert as claimed in any preceding claim wherein the thickness of the encapsulated element and the rigid material is predetermined.

8. An insert as claimed in claim 7 wherein the rigid material is a glob top resin and is deformed, upon encapsulation of the element and before setting to the predetermined thickness.

9. An insert as claimed in any preceding claim wherein the substrate or the substrate and the membrane support a plurality of ringed, encapsulated elements.

10. An insert as claimed in any of claims 1 to 9 wherein the element is an electronic component, the substrate bears an electrical circuit and wherein electrical connectors from the element to the electrical circuit on the substrate are also encapsulated by the rigid material.

11. An insert substantially as hereinbefore described

with reference to and as illustrated in the accompanying drawings.

12. A card or token formed of a pliant material and incorporating an insert as claimed in any preceding claim.

13. A card or token as claimed in claim 12 comprising a first layer of pliant material, and a second layer of pliant material with the insert sandwiched therebetween.

14. A card or token as claimed in claim 12 or 13 wherein the insert lies on the neutral axis of the card.

15. A card or token as claimed in claim 13 or 14 wherein the first and second layers are formed of a mouldable material.

16. A card or token as claimed in claim 13, 14 or 15 wherein the first and second layers are formed of a thermoplastics material.

17. A card or token as claimed in any of claims 13 to 16 wherein the first and second layers have planar external surfaces and internal surfaces conforming to the insert.

18. A card or token as claimed in any of claims 13 to 17 wherein one or both of the external surfaces of the first and second layers bears printed or other graphical representations.

19. A card or token as claimed in claims 15 and 17 wherein the first and second layers are formed by injection of a liquid mouldable material at each side of the insert.

20. A card or token as claimed in any of claims 13 to 19 further including a respective skin adhesively mounted on the or each external surface of the first and second layers.

21. A card or token as claimed in claim 20 wherein the or each skin bears printed or other graphical representations.

22. A card or token substantially as hereinbefore described with reference to and as illustrated in Figures 7, 8, 9, 10 or 11 of the accompanying drawings.

23. A method of manufacturing an insert, for a pliant card or token, comprising the steps of mounting an element to be protected upon a substrate, encapsulating the element in a rigid material, surrounding the encapsulated element

with a contiguous ring of material of compliance less than that of the pliant card or token, and deforming the ring of material to taper outwardly from the encapsulated element.

24. A method as claimed in claim 23 wherein the rigid material is a plastics material and including the step of deforming the encapsulating material, before the material has set, to a predetermined thickness.

25. A method as claimed in claim 23 or 24 wherein the ring is dispersed as a highly adhesive liquid and is cured in site.

26. A method as claimed in claim 23, 24 or 25, including the step of superimposing a membrane over the encapsulated element and the ring and deforming the membrane to conform thereto.

27. A method as claimed in claim 26 including the steps of deforming the substrate substantially symmetrically with the membrane.

28. A method as claimed in any of claims 23 to 27 wherein the element is an electronic component and the substrate bears an electrical circuit and including the step

of providing electrical connections between the electronic component and the electrical circuit and encapsulating both the element and the electrical connections with the rigid material.

29. A method as claimed in claim 28 wherein a plurality of encapsulated elements, each with its ring, are mounted upon the substrate, and wherein the membrane and the support are simultaneously deformed to conform substantially symmetrically to the encapsulated elements and their rings.

30. A method as claimed in any of claims 23 to 29 including the step of sandwiching the insert between first and second layers of the pliant material to form the card or token.

31. A method as claimed in claim 30 including the steps of pre-printing an external surface of the first and/or the second layer.

32. A method as claimed in any of claims 23 to 29 including the step of forming a layer of a liquid mouldable composition at each side of the insert and allowing the composition to solidify.

33. A method as claimed in claim 30 or 32 wherein the layers are provided in a mould with the insert therebetween and the mould is closed causing the internal surfaces of the layers to conform to the insert.

34. A method as claimed in claim 33 wherein the mould is first closed to a hold position during which heat is applied to the layers or the layers and the insert and, thereafter, the mould is closed to a moulding position to cause the layers to mould into conformity with the insert.

35. A method as claimed in claim 30 or 31 including the step of coating at least one of those surfaces of the first and second layers, or of the insert, which confront with an adhesive.

36. A method as claimed in claim 35 wherein the adhesive is heat activated and the layers are brought together with the insert therebetween and heat is applied.

37. A method as claimed in any of claims 30 to 36 further including the step of providing a skin at the external surface of the first and/or the second layer.

38. A method as claimed in claim 37 wherein the skin

or at least one of the skins is pre-printed.

39. A method of manufacturing an insert or a card or token including an insert substantially as hereinbefore described.

40. A method of manufacturing a card or token comprising the steps of interposing between first and second layers of a pliant material, a substrate having an element to be protected mounted thereon with a glob top resin settable to a rigid state applied to and encapsulating the element and a ring of a material of compliance less then that of the first and second layers, surrounding and contiguous with the glob top resin, deforming the ring so that it tapers outwardly of the encapsulated element and deforming the inner surfaces of the first and second layers so that they conform to the encapsulated element and its ring.

41. A method as claimed in claim 40 further including the steps of interposing a flexible membrane between the encapsulated element and surrounding ring and the confronting surface of the first or second layer and deforming the membrane to conform to the encapsulated element and its ring.

42. A method as claimed in claim 41 further including the step of deforming the substrate and the membrane substantially symmetrically about the encapsulated element and its ring.

43. A method as claimed in claim 40, 41 or 42 including the step of applying a skin to the external surface of the first and/or second layer.

44. A method as claimed in any of claims 40 to 43 wherein the layers with the interposed encapsulated element, its ring and the substrate are positioned relative to one another, and then heat and thereafter pressure is applied to the outer surfaces.

45. A method as claimed in any of claims 40 to 44 wherein the layers are brought together, with the encapsulated element, its ring and the substrate, under vacuum.

46. A method of manufacturing a card or token as claimed in any of claims 40 to 45 and substantially as hereinbefore described.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

GB 9211682.1

Relevant Technical fields

(i) UK Cl (Edition K) B6A (AK)

(ii) Int Cl (Edition 5) G06K

Search Examiner

G J W RUSSELL

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

22 SEPTEMBER 1992

Documents considered relevant following a search in respect of claims 1-46

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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